Beyond Control Centers
draft 1

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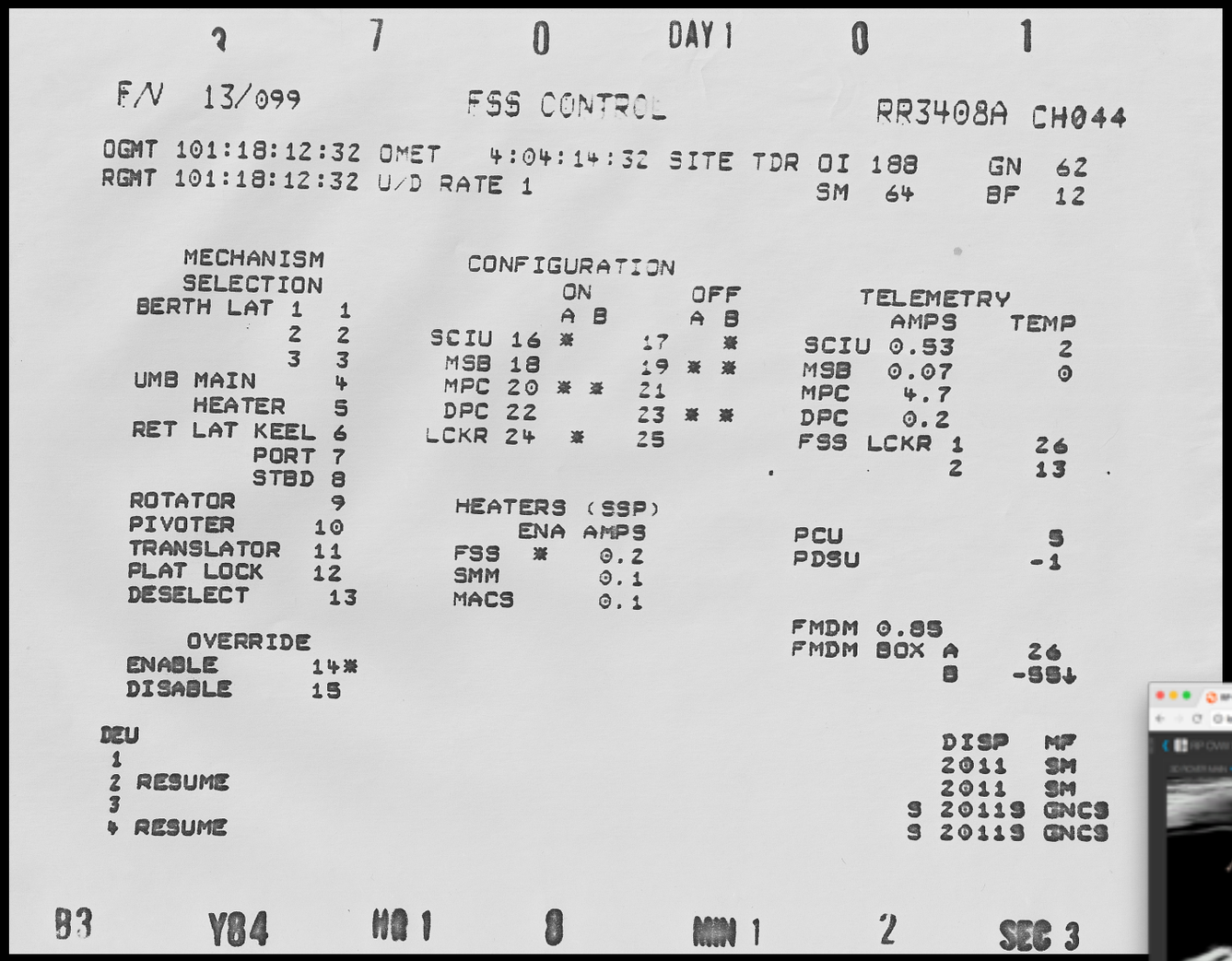
NASA Ames Research Center
Spaceops Workshop 2017

Control Centers

What do the consoles do?

A Long Way



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2      7      0      DAY 1      0      1

F/V  13/099              FSS CONTROL                    RR3408A CH044

OGMT 101:18:12:32 OMET   4:04:14:32 SITE TDR OI 188     GN  62
RGMT 101:18:12:32 U/D RATE 1                    SM  64     BF  12

    MECHANISM
     SELECTION
 BERTH LAT 1   1
           2   2
           3   3
 UMB MAIN      4
     HEATER    5
 RET LAT KEEL  6
         PORT  7
         STBD  8
 ROTATOR       9
 PIVOTER      10
 TRANSLATOR   11
 PLAT LOCK    12
 DESELECT      13

     OVERRIDE
 ENABLE       14*
 DISABLE      15

DEU
 1
 2 RESUME
 3
 4 RESUME

     CONFIGURATION
            ON       OFF
            A B      A B
 SCIU 16    *    17     *
  MSB 18         19  *  *
  MPC 20  *  *   21
  DPC 22         23  *  *
 LCKR 24    *    25

     HEATERS (SSP)
         ENA  AMPS
 FSS     *     0.2
 SMM           0.1
 MACS          0.1

     TELEMETRY
          AMPS    TEMP
 SCIU     0.53       2
 MSB      0.07       0
 MPC       4.7
 DPC       0.2
 FSS LCKR  1         26
           2         13

 PCU                  5
 PDSU                -1

 FMDM 0.85
 FMDM BOX A          26
        B          -55↓

                DISP   MF
                2011   SM
                2011   SM
            S   20119  GNCS
            S   20119  GNCS

B3      Y84      HR 1      8      MIN 1      2      SEC 3
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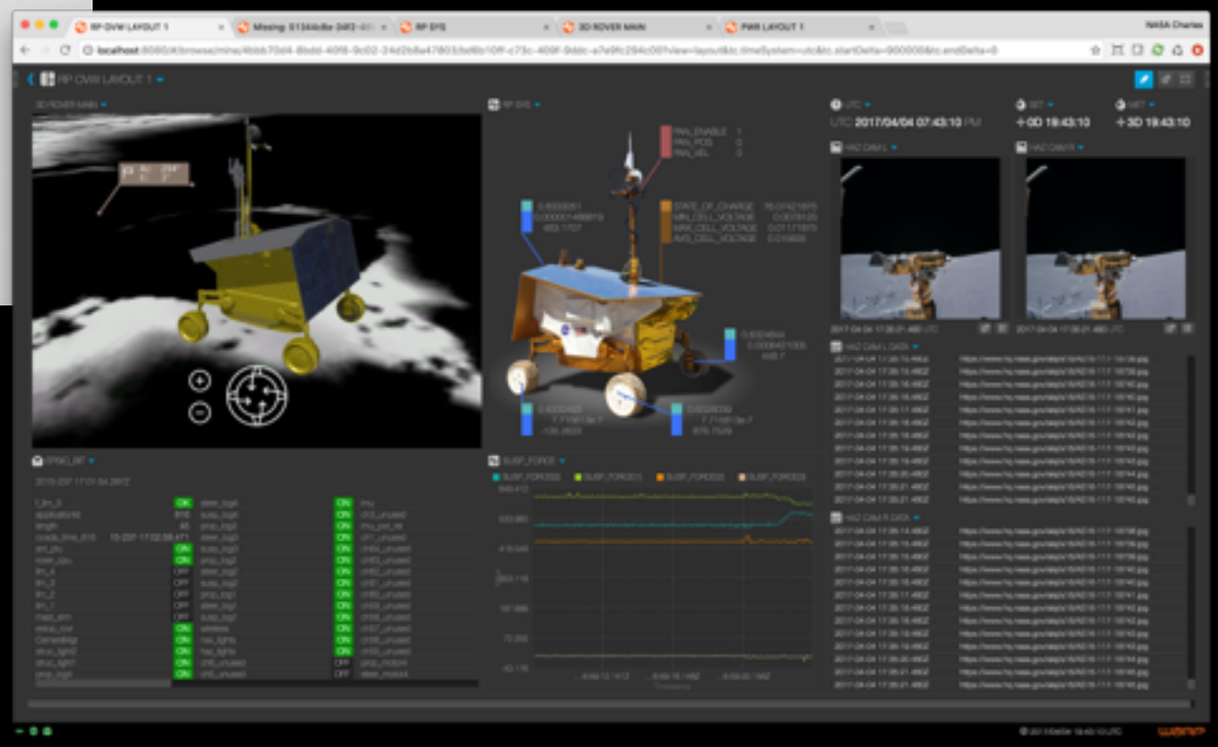
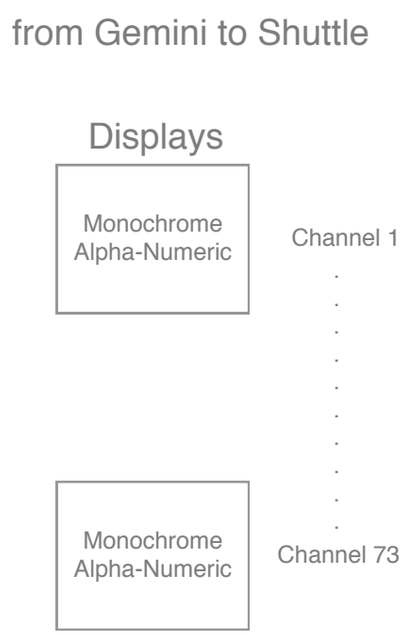
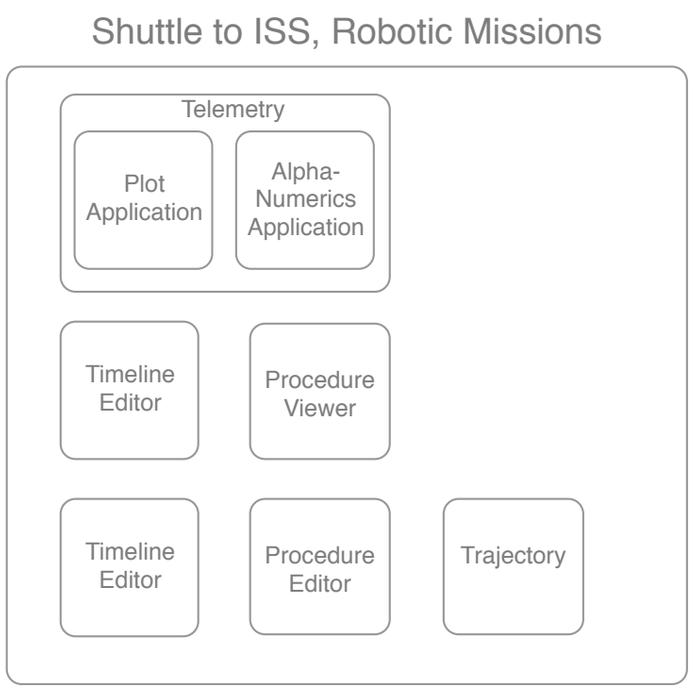
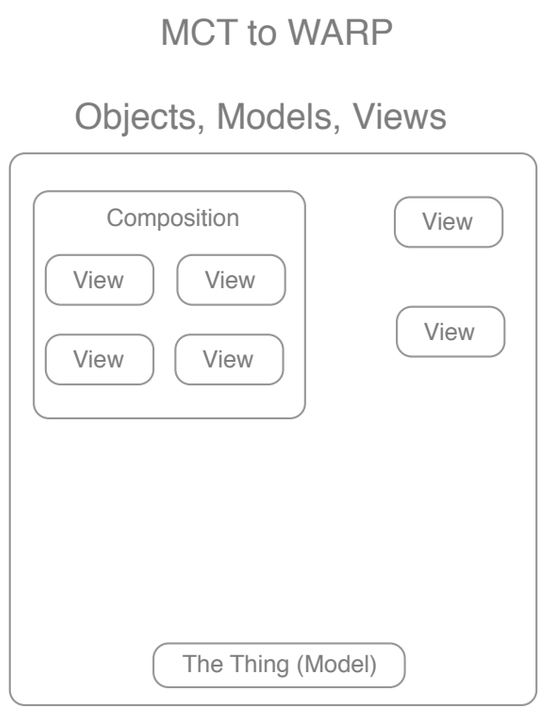
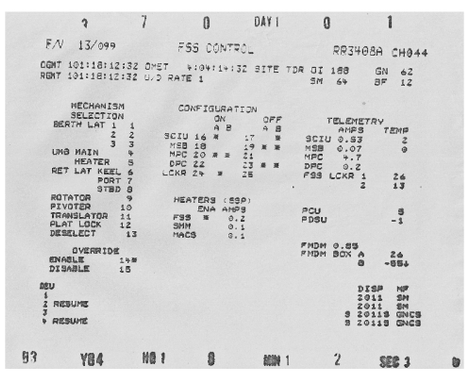


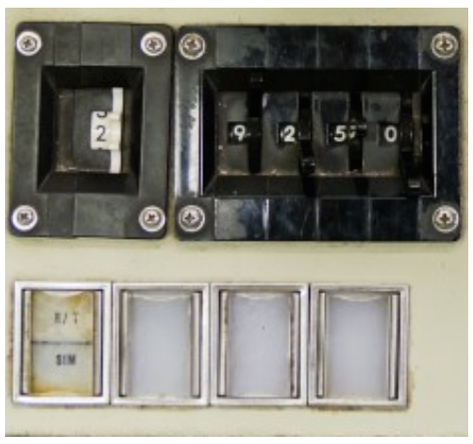
Mental Models - Displays, Applications, Objects

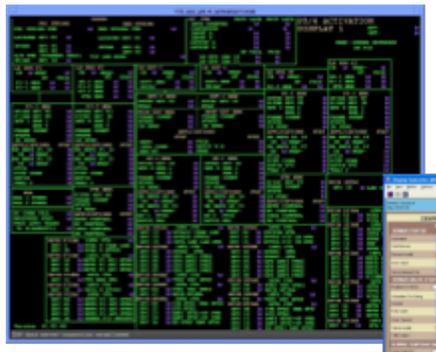


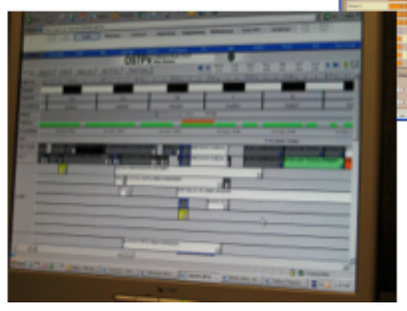


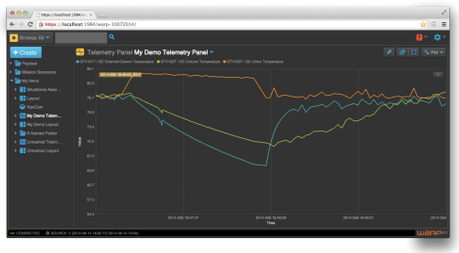


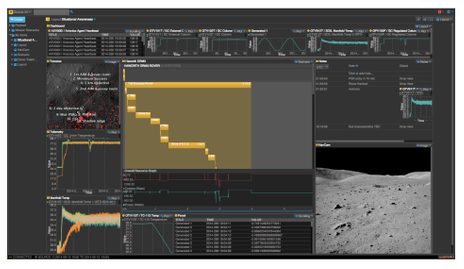










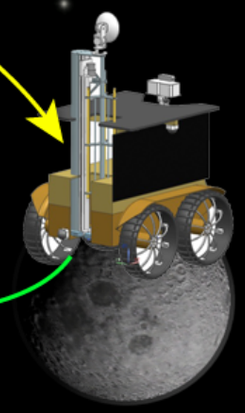


Resource Prospector

Commands

Round Trip Command
to Telemetry Receipt
~6 seconds

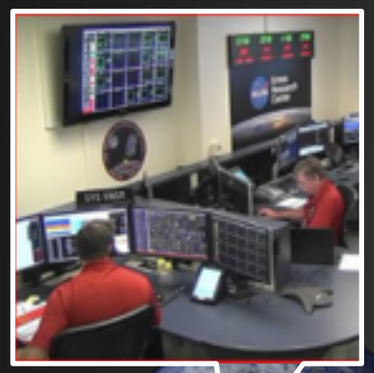
Telemetry/Data



Physical Co-Location

- Why co-location?
- Gestures
- Face to face

Mission Operations



1. Monitor health & status
2. Examine science data
3. Examine other data
4. Decide what to do next
5. Command spacecraft

*command**

*telemetry**

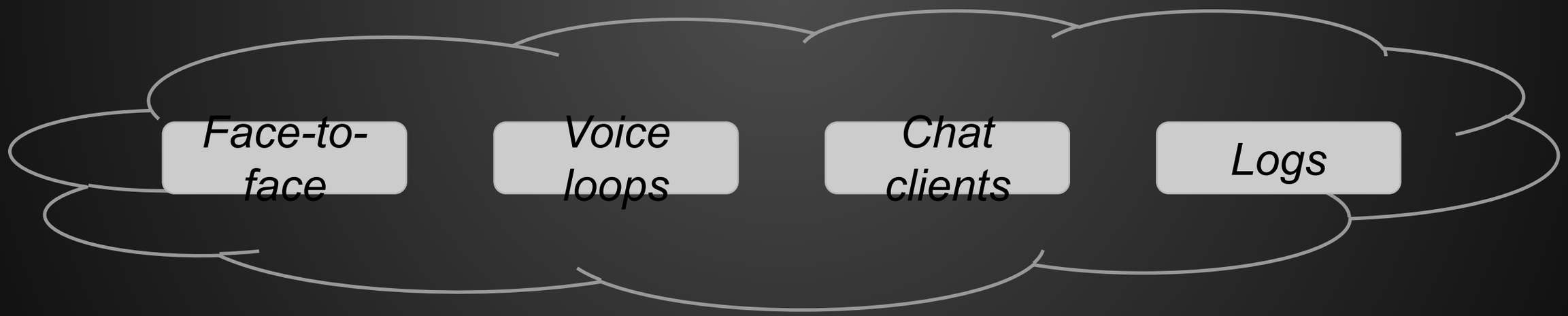
* Intermediaries (such as satellites and ground stations) omitted for simplicity.

Multi-Disciplinary Operations

Operations	Engineering	Science
Flight directors, planners, and decision-makers who conduct the mission.	Specialists monitoring the health and status of subsystems, instruments.	Experts in areas pertinent to the science goals of the mission.

Personnel from many different areas of expertise collaborate and contribute toward achieving mission goals.
Effective communication is essential!

Multi-Disciplinary Communication



Mission Tools

Operations personnel use a broad variety of tools to work with a broad variety of data.

- Telemetry visualization
  - Plots
  - Alphanumerics
  - Dense displays
- Telemetry dictionaries
- Data product viewers
  - Imagery
  - Spectra
- Procedures
  - Viewers, editors
  - Executors
- Planning tools
  - Timeline-based
  - Traverse-based
- Clocks, timers
- Session management
- Commanding
  - Issue commands
  - Sequencers
- Text editors
- Version control systems
- Webcams
- Console logs
- Simulators

Mission Requirements

New missions do new things. The hardware, software, and human processes that worked for one mission may not be appropriate for e





History

- The early Mercury Control Centers were distributed around the world
- Centralization became possible only with advances in communications and tracking networks